

EDUCATION:

1967 - B. Electrical Engineering (Communications), National University of La Plata, Argentina.

1976 - Ph.D. Electrical Engineering (Control and Systems Theory), University of New South Wales, Sydney, Australia.

RESEARCH INTERESTS:

Gravity field mapping from space; determination of orbits of artificial satellites; precise static and kinematic positioning using the Global Positioning System; precise aircraft navigation for geophysical surveys from the air; airborne gravimetry; measurement of small changes in the gravity field associated with global geophysical processes.

AWARDS:

Weiko and Karina Heiskanen Award for Contributions to Geodesy, 1983.

Shared several NASA Achievement Awards for contributions to gravity field mapping and uses of spacecraft data for the study of the solid earth and oceans.

PROFESIONAL SOCIETIES AND ACTIVITIES:

President I.A.G. Special Study Group on Precise Orbit Determination, 1987-91.

Member, Institute of Navigation (ION), 1991- to date.

Member of IAG Special Study Group on Kinematic GPS, 1999 - 2003.

Co-Chair of IAG Working Group 4.5.3: High Precision Positioning on Buoys and Moving Platforms; 2003-to date.

Fellow of the International Association of Geodesy (I.A.G.), 1991- to date.

EMPLOYMENT HISTORY:

1965-67 Teaching Assistant, National University of la Plata, Argentina

1968-71 Staff Engineer, Standard Telephone and Cable, Sydney, Australia.

1972-78 Teaching Fellow, School of Electrical Eng., Univ. of New South Wales, Sydney, Australia.

1978-80 Visiting Scientist, Dept. of Earth and Planetary Science, Johns Hopkins University, Baltimore, U.S.A.

1978-80 Visiting Scientist, John Hopkins University and Ohio State University.

1980-83 Visiting Scientist, Stuttgart and Darmstadt Universities, Germany, and Delft Technical University, Holland.

1983-88 Senior Scientist, EG&G W.A.S.C. Lanham, Maryland, U.S.A.

1989-98 Research Associate, University of Maryland at College Park/ GSFC Code 926.

1997-98 Visiting Professor, Delft University of Technology, Holland.

1999 Visiting Professor, Technical University of Denmark.

1998-2000 USRA (Universities Space Research Association)/NASA Goddard Space Flight Center, Code 926.

2000- Present GEST (Goddard Earth Science and Technology)/NASA Goddard Space Flight Center, Code 926.

PAST WORK: MAIN AREAS AND ACHIEVEMENTS.

Creator of data analysis techniques that have been incorporated in the main orbit determination, tidal, and gravity analysis procedures used routinely at the Laboratory for Terrestrial Physics at NASA's Goddard Space Flight Center, at CNES in France, and at various universities and institutions around the world.

Most modern high-resolution spherical harmonic models of the Earth's gravity field (degree and order 360 or higher) have been computed using methods formulated by Dr. Colombo in the late Seventies, and further developed by others.

He is the original proponent of the NASA "TIDES", now "GRACE Follow On" mission to map changes in the Earth's gravity field from space using ultra-stable laser interferometry.

Proponent of the now widely accepted idea that a mission of the sensitivity of "TIDES" could be used to map changes in the pressure field at the sea floor. From this changes in the deep-ocean circulation could be inferred and monitored, providing valuable information for understanding global climate change.

Participant in a number of studies, funded by NASA and other agencies, of most of the advanced gravity field mapping missions proposed so far, developing mission analysis procedures now in general use.

As early as 1986-87, with two other colleagues, made the first precise analysis of GPS measurements carried out at Goddard SFC, using data from the Spring '85 Experiment. This early work demonstrated positional accuracy of better than one part in 10,000,000 for baselines several thousands of kilometers long.

In recent years, he has developed and tested a long-baseline radiolocation procedure of sub-decimeter precision using GPS. Its purpose is to enable remote-sensing surveys over large areas (polar regions, oceans, large deserts), for very precise geographic data registration, as well as velocity and acceleration corrections.

INTERNATIONAL PARTICIPATION:

Past President of the Special Study Group of the IAG for Precise Orbit Determination.

Several times author of the Space Geodesy chapter of the U.S.A. National Report on Geodesy and Geophysics presented to consecutive General Assemblies of the I.A.G. Organizer of several national and international technical meetings, and main convenor and editor of the proceedings of the international IAG Symposium on Gravity Field Determination by Space and Airborne Methods that took place during the General Assembly of the International Union of Geodesy and Geophysics, in Vienna, in August 1991.

Co-Organizer of sessions on kinematic GPS at the "GraGeoMar" symposium in Tokyo, October 1996, and at the "GPS For Geodesy" meeting in

Tsukuba, Japan, October 1999.

Organizer of the Geodesy Section of the Western Geophysics Meeting 2000, of the American Geophysical Union.

Since 1998, has worked in close collaboration with colleagues at the Universitat Politècnica de Catalunya, Spain, on the use of models of ionospheric refraction derived from ionospheric tomography to achieve long-range, real-time GPS navigation at the sub-decimeter level.

Collaborates with colleagues at the Danish Cadaster and Mapping Service (KMS), in Denmark, on using precise GPS navigation in support of airborne altimetry and gravimetry.

Since 2004, Project Partner in UK SVAL-ICE Project: “Changes in Glacier Geometry and Extent in Svalbard”, T. Murray, U. of Leeds, PI. This is a multi-year project with 16 participants from several UK Universities and the Russian Academy of Sciences. Project involves monitoring glacier thickness with repeated airborne lidar surveys, using GPS for precise geographic registration of the lidar data.

Co-Chair of IAG Working Group 4.5.3: High Precision Positioning on Buoys and Moving Platforms; 2003-2005.

(Full Publication List)

FULL PUBLICATION LIST

1998-2007 Publications on Applications of the Global Positioning System (GPS):

2006 GPS/Acoustic Seafloor Geodetic Observation: Method of Data Analysis and its Application, Fujita, M., T. Ishikawa, M., Mochizuki, M., Sato, S. Toyama, M. Katayama, K. Kawai, Y. Matsumoto, T. Yabuki, A. Asada, and O.L. Colombo, (Earth Planets Space, **58**, 265–275, 2006).

2006 Colombo, O.L., A Zenith Delay Model for Precise Kinematic Aircraft Navigation; Proceedings of the ION GNSS-2006, Fort Worth, Texas.

2005 Colombo, O.L., M. Hernandez-Pajares, M. Juan, J. Sanz, Extending Wide Area and Virtual Reference Station Networks Far Into the Sea With GPS Buoys, Proceedings of the ION GNSS-2005, Long Beach, California.

2004 Colombo, O.L., A.W. Sutter, A.G. Evans, Evaluation of Precise, Kinematic GPS Point Positioning, Proceedings ION GNSS-2004, Long Beach, September 2004.

2004 Colombo, O.L., S.B. Luthcke, Kinematic Point Positioning of a LEO With Simultaneous Reduced-Dynamic Orbit Estimation, Proceedings ION GNSS-2004, Long Beach, California, September 2004,

2003 Hernandez-Pajares, M. Juan, J.M. Sanz, J. Colombo, O.L.: Impact of Real-Time Ionospheric Determination on Improving Precise Navigation with GALILEO and Next-Generation GPS, “Navigation” : J. Inst. Navig., Alexandria, Virginia, 50(2003)3. - pp. 205-218, 2003

2003 Hernandez-Pajares, M., J.M. Juan, J. Sanz, O.L. Colombo, Feasibility of Wide-Area Sub-decimeter Navigation with GALILEO and Modernized GPS, "IEEE Transactions on Geoscience and Remote Sensing", Vol. 41, No. 9, pp 2128-2131, 1 September 2003

2003 Colombo, O.L., A.W. Sutter, A.G. Evans, Evaluation of Real-Time, Long-Range, Precise, Differential, Kinematic GPS Using Broadcast Orbits, Proceedings ION GNSS-2003, Portland, Oregon, September 2003.

2003 Colombo, O.L., A.W. Sutter, A.G. Evans, A System for Long-Range, Precise, Differential GPS Navigation in Real Time, Proceedings 5ta. Setmana Geodetica, Barcelona, Spain, February 2003.

2002 Colombo, O.L., S.B. Luthcke, D.D. Rowlands, D. Chin, S. Poulou, Filtering Errors in LEO Trajectories Obtained by Kinematic GPS With Floated Ambiguities, Proceedings ION GNSS-2002, Portland, Oregon, September 2002

2002 Hernández-Pajares M., J.M. Juan, J. Sanz and O. Colombo, Improving the real-time ionospheric determination from GPS sites at Very Long Distances over the Equator, Journal of Geophysical Research – Space Physics, (A) Vol. 107, pp.1296-1305, 2002.

2002 Colombo, O.L., M. Hernandez-Pajares, J.M. Juan, J. Sanz, Wide-Area, Carrier-Phase Ambiguity Resolution Using a Tomographic Model of the Ionosphere, "Navigation", J. Inst. Navig., Alexandria, Virginia, Vol.41, No.1, Spring 2002.

2001 Colombo, O.L., E.G. Evans, Precise, Very Long Range Marine Positioning With GPS: Achieving Sub-Decimeter Precision in a Matter of Minutes, Proceedings "Oceans 2001", Hawaii, November 2001.

2001 Hernandez-Pajares, M., J.M. Juan, J. Sanz, O.L. Colombo, A new strategy for real-time integrated water vapor determination in WADGPS networks, GRL, Vol. 28, No. 17, pp 3267-3270, September 2001.

2000 Colombo, O.L., A.G. Evans, M. I. Vigo, J.J. Benjamin, J.M. Ferrandiz, Long-baseline (> 1000 km), Sub-Decimeter Kinematic Positioning of Buoys at Sea, With Potential Application to Deep-Sea Studies, Proceedings of the GPS-2000 Meeting of the Institute of Navigation, Salt Lake City, September 2000.

2000 Hernandez-Pajares, M., J.M. Juan, J. Sanz, O.L. Colombo, Application of ionospheric tomography to real-time GPS carrier-phase ambiguities resolution at scales of 400 - 1000 km and with high geomagnetic activity, GRL, Vol. 27, No. 13, pp. 2009-12, 1 July 2000.

2000 Colombo, O.L., M. Hernandez-Pajares, J.M. Juan, J. Sanz, Ionospheric Tomography Helps Resolve GPS Ambiguities On The Fly At distances Of Hundreds Of Kilometers During Increased Geomagnetic Activity, Colombo, O.L., M. Hernandez-

Pajares, J.M. Juan, J. Sanz, Proceedings of the IEEE PLANS 2000, San Diego, California, March 2000.

2000 Colombo, O.L., Detecting Tsunami in the High Seas: How GPS Might Contribute to an Early Warning System, Proceedings, National Technical Meeting of the Institute of Navigation (ION) Anaheim, California, January 2000.

1999 Colombo, O.L., A.E. Evans, Sea And Land Tests Of Long-Baseline Kinematic GPS Indicate Sub-Decimeter-Level Precision, Proceedings of the International Symposium on Marine Positioning (INSMAP), University of Southern Florida, Melbourne, Florida, December 1999.

1999 Colombo, O.L., M. Hernandez-Pajares, J.M. Juan, J. Sanz, and J. Talaya, "Resolving carrier-phase ambiguities on-the fly, at more than 100 km from nearest site, with the help of ionospheric tomography", Proceedings ION GPS'99, Nashville, Tennessee, USA, September 1999.

1999 Hernandez-Pajares, M., J.M. Juan, J. Sanz, O.L. Colombo, Precise ionospheric determination and its application to real-time ambiguity resolution, Proceedings ION GPS-99, Nashville, Tennessee, September 1999.

1999 Colombo, O.L., U.V. Bhapkar, A.E. Evans, Inertial-Aided Cycle-Slip Detection/Correction for Precise, Long-Baseline Kinematic GPS, Proc. ION GPS'99, Nashville, Tennessee, September 1999.

1998 Colombo, O.L., A. E. Evans, Precise, Decimeter-level Differential GPS Over Great Distances at Sea and on Land, Proceedings ION GPS-98, Nashville, Tennessee, September 1998.

1998 Colombo, O.L., Long-Range Kinematic GPS, In "GPS for Geodesy", P. Teunissen and A. Kleusberg, Editors, Springer Verlag, Lecture Notes in Earth Sciences.

ALL PUBLICATIONS BEFORE 1998

As First Author:

1997 Colombo, O.L., Chao, B. F., Advanced Techniques for Mapping the Gravity Field from Space, Proceedings of GraGeoMar '97, Gravity, Geodesy and Marine Positioning Symposium, Tokyo University, October 1996; Springer-Verlag.

1996 Colombo, O.L., Evans, A., Tests of Decimeter-level, DifferentialGPS Navigation a Long Distance away from any Reference Station, with Implications for Marine Positioning, GraGeoMar '97, Gravity, Geodesy, and Marine Positioning Symposium, Tokyo University, October 1996, Spinger Verlag; in print.

1995 Colombo, O.L., Rizos, C., B. Hirsch, Long-Range Carrier Phase DGPS: The Sydney Harbour Experiment. Proceedings of The 4th International Conference on Differential Satellite Navigation Systems "DSNS 95", Bergen, Norway 24 - 28 April 1995

1995 Colombo, O.L., Rizos, C., B. Hirsch, Decimeter-Level DGPS Navigation over Distances of more than 1000 km: Results from the Sydney Harbour Experiment. Proceedings Mobile Mapping Symposium Proceedings, Columbus, Ohio, May 24-26, 1995

1992 Colombo, O.L., (editor), From Mars to Greenland: Charting Gravity with Space and Airborne Instruments, Proceedings I.A.G. Symposium 110, Vienna, Austria, August 1991, Springer-Verlag, New York.

1992 Colombo, O.L., Chao, B.F., Global Gravity Change in 2001, Proc. I.A.G. Symposium 112, "Geodesy and Physics of the Earth", C.Reigber (Ed.), pp. 71 - 75, Springer-Verlag, Heidelberg, 1992.

1992 Colombo, O.L., Precise Differential GPS Navigation for Long-Range Airborne Geophysics, Proceedings International Workshop Honoring George Veiss "Global Positioning Systems in Geosciences", Techn. Univ. of Crete, Chania, Greece.

1992 Colombo, O.L., Precise GPS Orbits for Geodesy, Proceedings COSPAR Meeting PM-1, XXIX COSPAR Plenary Meeting, World Space Congress, 1992.

1992 Colombo, O.L., and Peters, M.F., Precision long-range DGPS for airborne surveys, GPS World, Vol. 3, No. 4, Aster Publishing Co.

1992 Colombo, O.L., Precise, long-range aircraft positioning with GPS: The use of data compression, Proceedings VI International Symposium on Satellite Positioning, Columbus, Ohio, March 17-20.

1991 Colombo, O.L., Airborne gravimetry, altimetry, and GPS navigation errors, Proceedings IAG Symposium on Determination of the Gravity Field from Space and Airborne Measurements, Vienna, 1991; Springer-Verlag, N.Y., in press.

1991 Colombo, O.L. (editor), From Mars to Greenland: Mapping Gravity with Space and Airborne Instruments, Proc. I.A.G. International Symposium on Gravity Field Determination from Space and Airborne Measurements, Vienna, August 1991, Springer-Verlag, N.Y.

1991 Colombo, O.L., Errors in long-distance kinematic GPS, Proc. Inst. of Navigation (ION) GPS-91, ION Satellite Division 4th International Technical Meeting, Albuquerque, New Mexico, September 1991.

1991 Colombo, O.L., and Watkins, M.W., Satellite positioning, Rev. of Geophys., "Contributions in Geodesy", Supplement, U.S. National Report to the International Union of Geodesy and Geophysics 1987-1990, Washington.

1990 Colombo, O.L., The use of gradiometers in space for monitoring changes in the gravity field of the Earth, Proc. 7th Annual Gravity Gradiometer Conference, October 1989, C.Jekeli and G.L. Shaw, editors, Geophysics Lab., Hanscom AFB, Mass., Report GL-TR-90-0067.

1990 Colombo, O.L., The role of GPS/INS in mapping the Earth's gravity field in the 1990's, Proc. International Symposium on Kinematic Systems in Geodesy, Surveying and Remote Sensing -KIS '90, Banff, Canada, September 10-13.

1990 Colombo, O.L., Mapping the Earth's gravity field with orbiting GPS receivers, Global Positioning System, an overview, Y. Bock and N. Leppard Eds., Proc. IAG Symp. 102 (Edinburgh, Scotland), IAG Symp. Series, 102, Springer-Verlag, N.Y.

1990 Colombo, O.L., Charting the gravity field with GPS receivers in moving vehicles, Proceedings The Second International Symposium on Precise Positioning with GPS -GPS 90, Ottawa, Canada.

1989 Colombo, O.L., The dynamics of GPS orbits and the determination of precise ephemerides, J. Geophys. Res., 94,B7, 9167-9182.

1989 Colombo, O.L., Gravity, in The Interdisciplinary Role of Space Geodesy, I.I. Mueller and S. Zerbini, editors, Springer-Verlag, N.Y..

1989 Colombo, O.L., Advanced techniques for high-resolution mapping of the gravitational field, in Theory of Satellite Geodesy and Gravity Field Determination, F. Sanso and R.Rummel, editors, Springer-Verlag, N.Y.

1987 Colombo, O.L., The global mapping of the gravity field with an orbiting full-tensor gradiometer: An error analysis, Proceedings of the I.A.G. Symposia, XIX General Assembly IUGG, pp. 250-266, Vancouver.

1987 Colombo, O.L., Geodetic Theory, Rev. of Geophys."Contributions in Geodesy", Supplement, U.S. National Report to the International Union of Geodesy and Geophysics 1983-1986 Washington.

1986 Colombo, O.L., Notes on the mapping of the gravity field using satellite data, in Mathematical and Numerical Techniques in Physical Geodesy, edited by H. Sunkel, Springer-Verlag, N.Y.

1986 Colombo, O.L., Ephemeris errors of GPS satellites, Bull. Geod., Vol. 60, No. 1, Paris.

1985 Colombo, O.L., Levelling with the help of space techniques, Proc. 3rd International Symposium on the North American Vertical Datum, Rockville, Maryland, April 21-26.

1984 Colombo, O.L., The global mapping of the gravity field with two satellites, Netherlands Geodetic Commission, Publications in Geodesy, New Series, Vol. 7, No. 3, Delft The Netherlands.

1984 Colombo, O.L., Altimetry, orbits and tides, NASA Tech.Mem. TM-86180.

1983 Colombo, O.L., Numerical calculation of covariances between area means, Bull. Geod., Vol. 57, No. 2, Paris.

1983 Colombo, O.L., and Kleusberg, A., Applications of an orbiting gradiometer, Bull. Geod., Vol. 57, No. 1, Paris.

1982 Colombo, O.L., Convergence of the external expansion of the gravity field inside the bounding sphere, Manuscripta Geodaetica, Vol. 7, pp. 209-246, Stuttgart.

1981 Colombo, O.L., Global Geopotential modelling from satellite-to-satellite tracking, Report 317, Dept. Geodetic Science, The Ohio State University, Columbus, Ohio.

1981 Colombo O.L., Numerical methods for harmonic analysis on the sphere, Report 310, Dept. of geodetic Science, The Ohio State University, Columbus, Ohio.

1980 Colombo, O.L., Transoceanic vertical datum connections, Proceedings 2nd International Symposium on problems related to the redefinition of North American Vertical Geodetic Networks, The Canadian Inst. of Surveying, Ottawa.

1980 Colombo, O.L., A world vertical network, Report 296, Dept. Geodetic Science, The Ohio State University, Columbus, Ohio.

1979 Colombo, O.L., Optimal estimation from data regularly sampled on a sphere, Report 1979, Dept. Geodetic Science, The Ohio State University, Columbus, Ohio.

1978 Colombo, O.L., Optimal kernels for band-limited data, Unisurv G27, University of N.S.W., Sydney, Australia.

1976 Colombo, O.L. On the control of discrete-time systems with constrained input and state variables, Doctoral dissertation, University of New South Wales, Australia.

Not First Author:

1988 Smith, D.E., F.J. Lerch, O.L. Colombo, C.W.F. Everitt, Gravity field information from Gravity Probe-B, Proc. AGU Chapman Conference on Progress in Determination of the Gravity Field, R. H. Rapp Editor, 159-163, Ohio State University.

1988 Marsh, J.G., et. al., Gravitational model improvement at Goddard Space Flight Center, Proc. AGU Chapman Conference on Progress in Determination of the Gravity Field, R. H. Rapp Editor, 159-163, Ohio State University.

1988 Marsh, J.G., et. al., A new gravitational model for the earth from satellite tracking data: GEM-T1, J. of Geophys. Res., Vol. 93, No. B6.

1985 Rummel, R., and Colombo, O.L., Gravity field determination from satellite gradiometry, Bull. Geod., Vol. 59, pp. 233-246, Paris.